

Between a Map and a Data Rod

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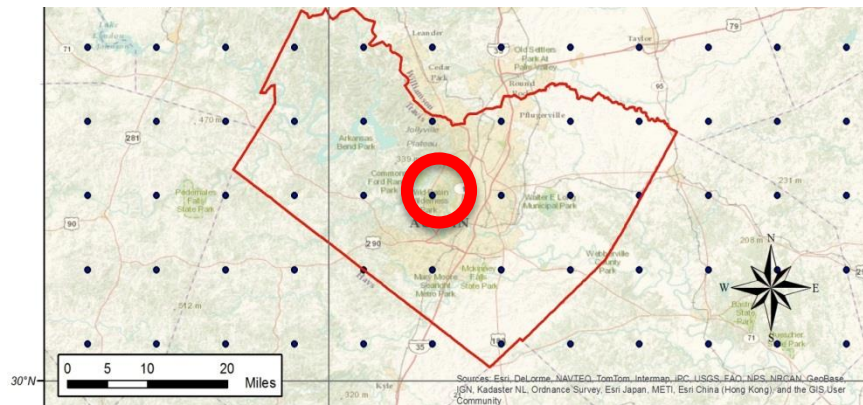
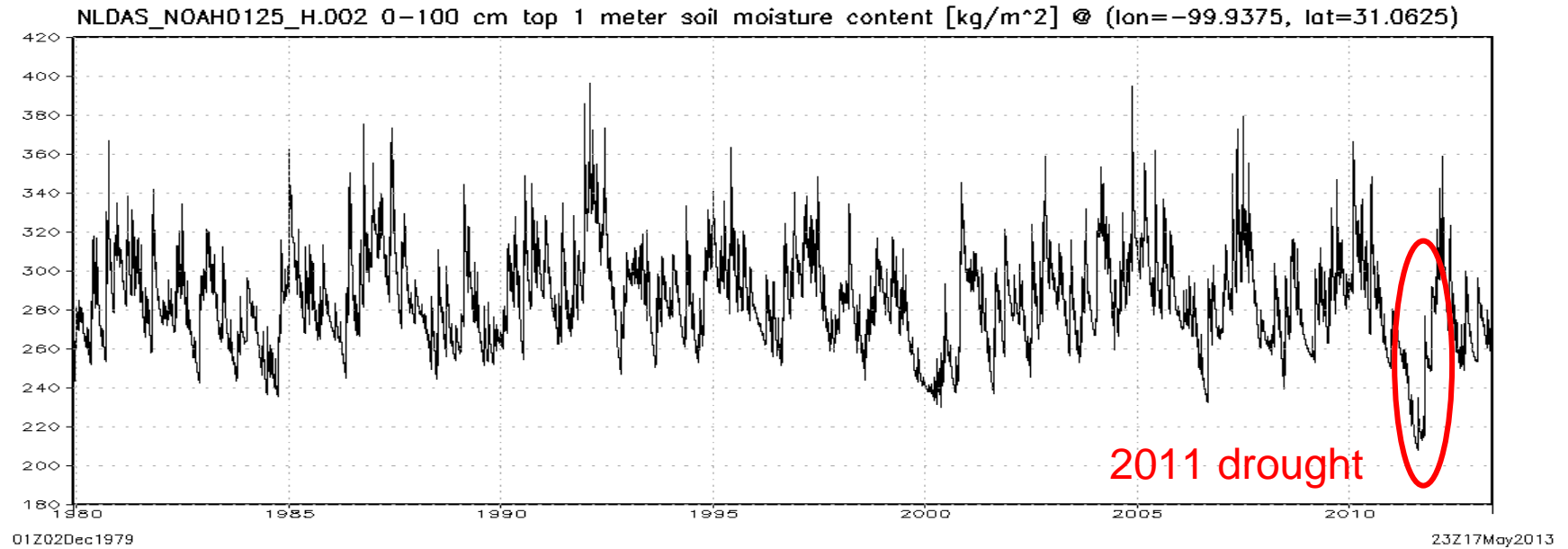
Brigham Young University: Daniel Ames

NASA ACCESS Program
NNH11ZDA001N-ACCESS
NNH13ZDA001N-ACCESS



Outline

- Motivation and background
- “Digital Divide” problem
- Solution: Pre-generated vs. on-the-fly
- Tiling, between a map and a data rod
- Summary and ongoing work



Time Series of top 1 meter soil moisture from NLDAS-2 Noah model, near the center of Texas (100W, 31N)

Courtesy of David R. Maidment
Center for Research in Water Resources
University of Texas at Austin



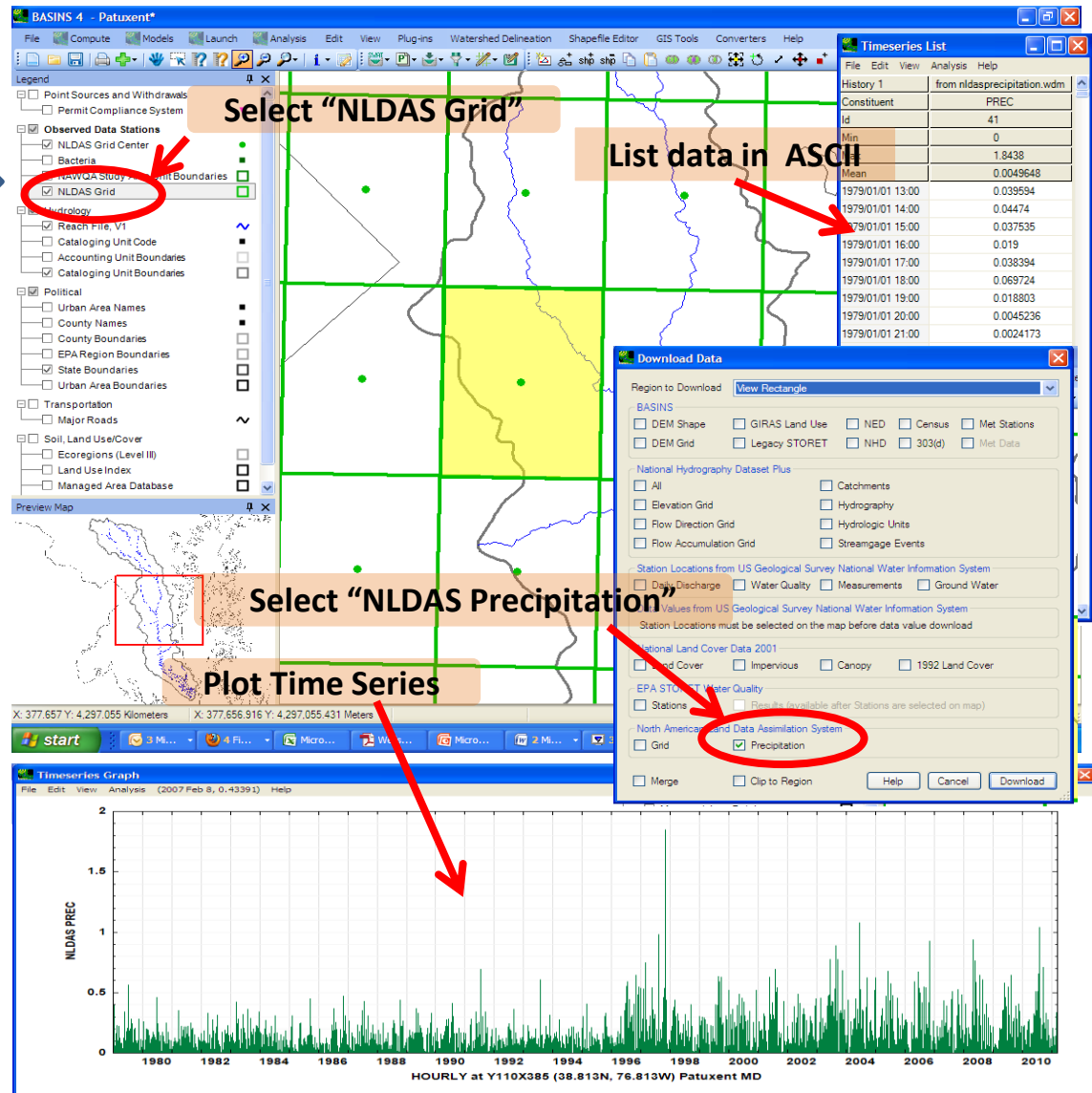
EPA BASINS¹ Prototype

Latitude x

DATA

Time

Curtain



¹Better Assessment Science Integrating Point and Nonpoint Sources



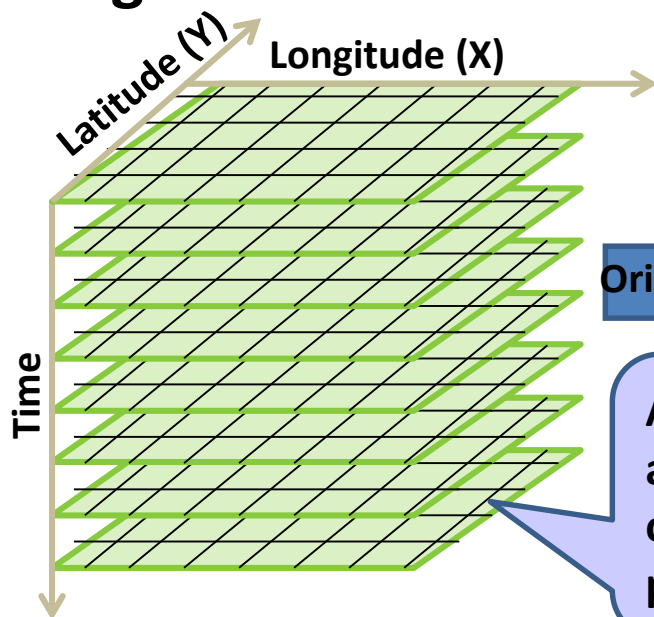
Digital Divide Problem ... Orthogonal

	Original GRIB Files								Data Rods Binary Files				
Noah LSM	Dimension lat x lon	Total # of Grids	# of /Files /day	Total # of years	Total # of Files	File Size (MB)	Total Vol (TB)	Land Fraction	# of Files /param	# of param	Total # of Files	File Size (MB)	Total Vol (TB)
NLDAS	224 x 464	103936	24	37	324120	6.8	2.2	0.7321	76088	21	1597848	1.295	2.07
GLDAS	600 x 1440	864000	8	16	46720	15.2	0.71	0.2813	243003	13	3159039	0.183	0.58
Total					370840		2.91				4756887		2.65



Data Rods: A Simple Solution for Bridging the Digital Divide

Original Data Archive

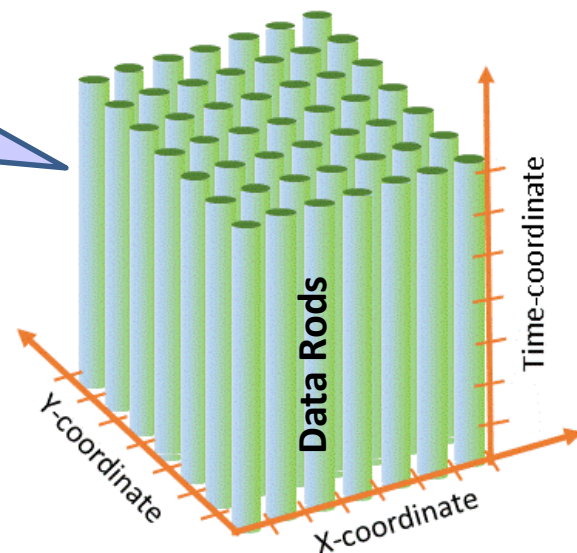


One variable
one grid point
all time steps
per file

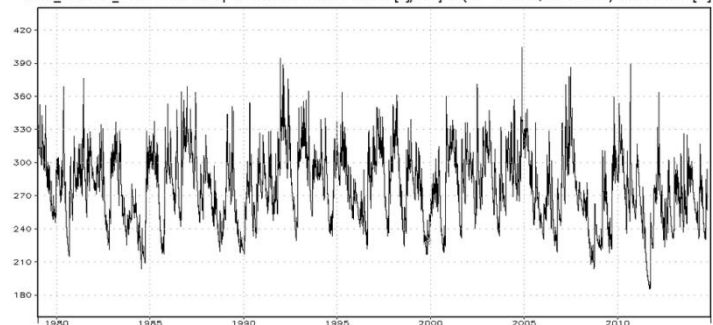
Original data reorganized as ...

All variables
all grid points
one time step
per file

Reorganized Data Archive



NLDAS_NOAH0125_H.002 0-100 cm top 1 meter soil moisture content [kg/m²] @ (lon=-97.9375, lat=31.0625) elev=297.057 [m]



00202Jan1979

Generated @ NASA GES DISC

232310ec2014

More than 324,000 time steps
(37 years) plotted in ~ 1 second



Generating Data Rods

GRIB File

Input file: Multi-variable, one time step per file

Parameter Subsetting
WGRIB

Bin File

Intermediate file: One variable, one time step per file

Grid Subsetting

Data Rods

Reorganized Data Rod files: One variable, one grid point, all time steps per file

Read user-specified file

RESTful Web Service

Specify variable, startDate, endDate, and location

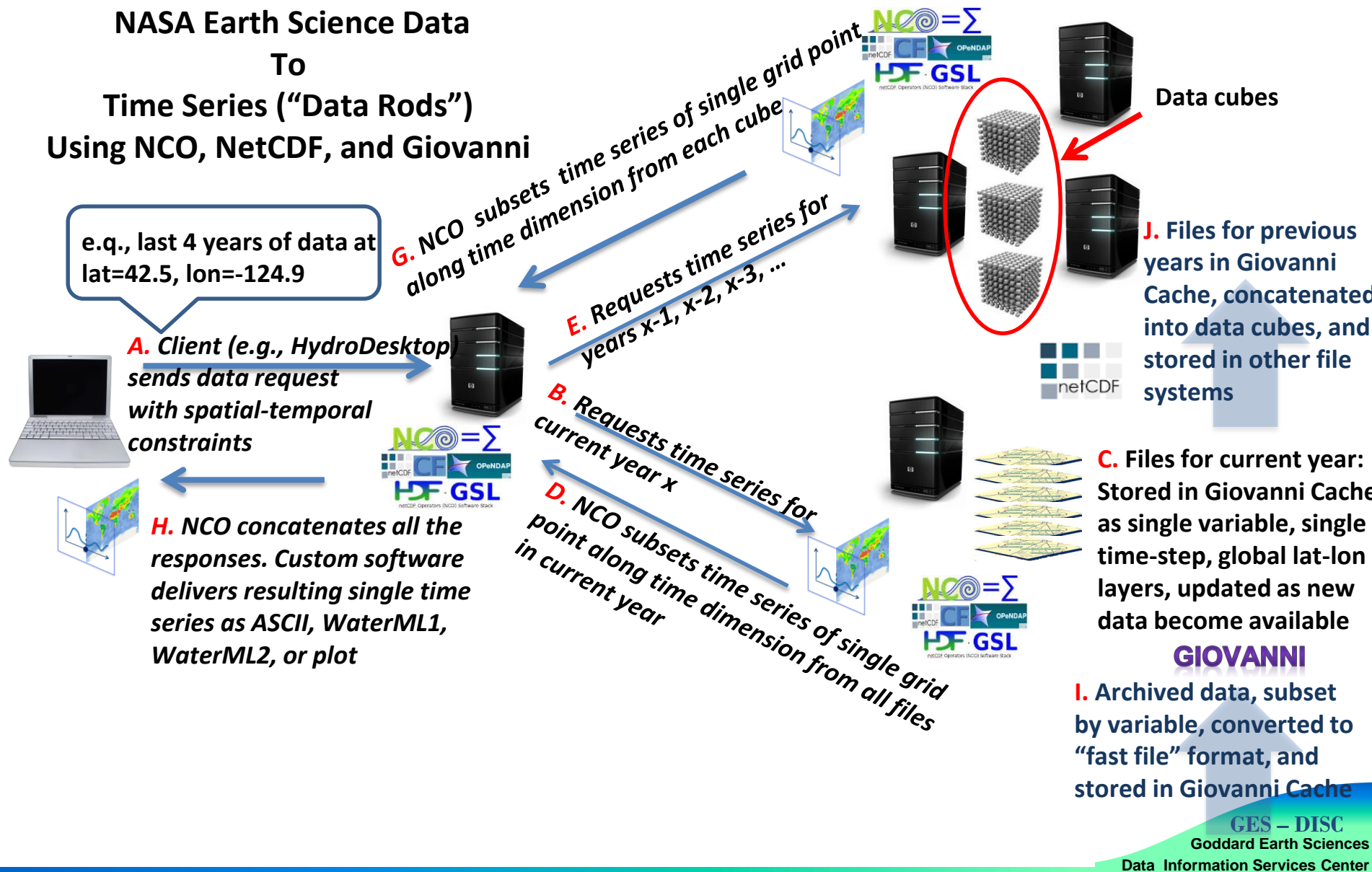
Display data in ASCII, WaterML, or Time Series plot

User

Delivering Data Rods to Users

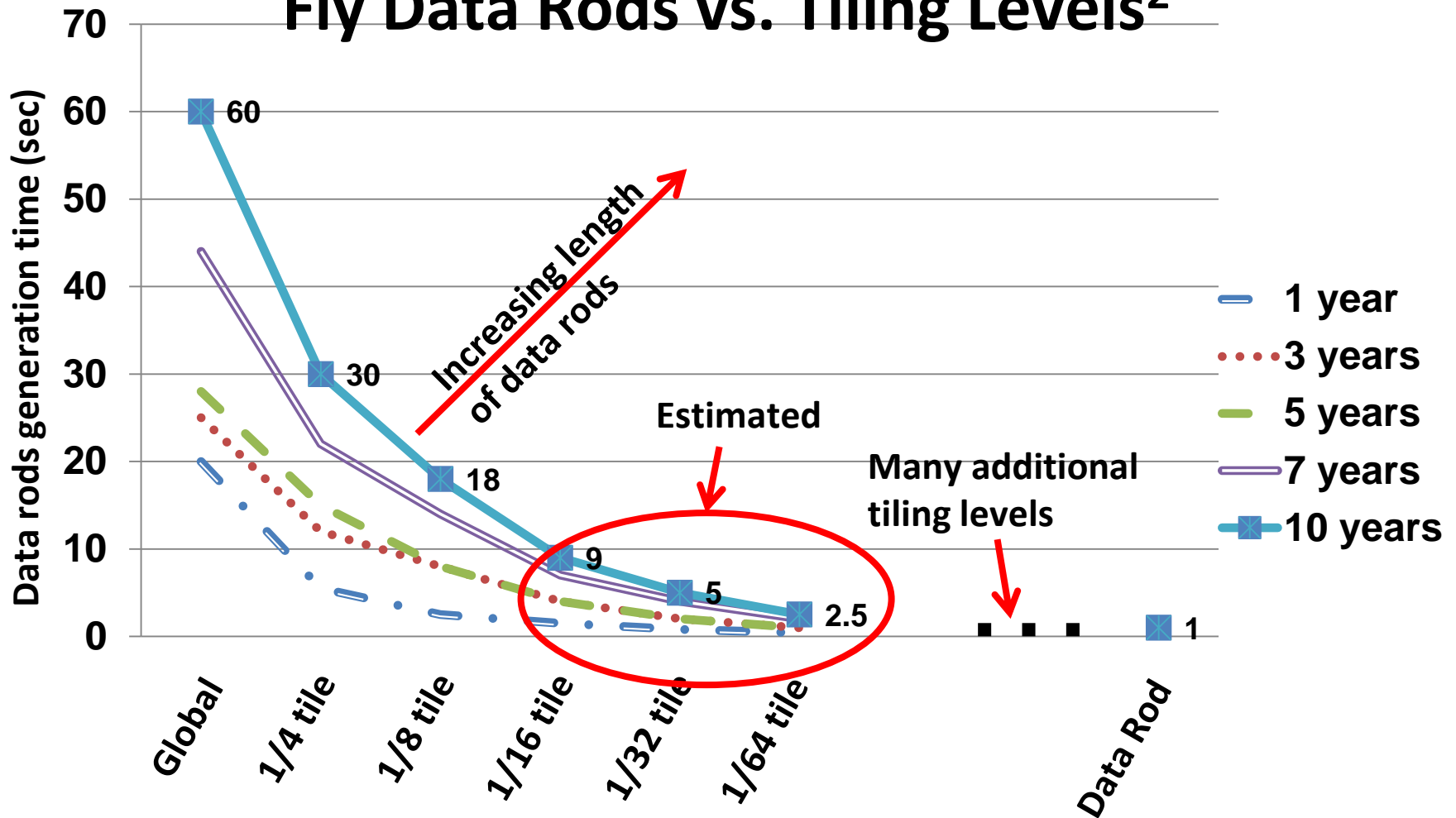


Global Level 3 (Gridded) Single Variable NASA Earth Science Data To Time Series (“Data Rods”) Using NCO, NetCDF, and Giovanni



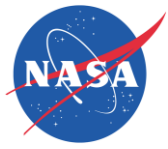


Generation Time for TRMM¹ On-the-Fly Data Rods vs. Tiling Levels²

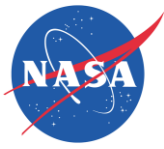


¹Tropical Rainfall Measuring Mission

²Tiling: Dividing the data set grid into subgrids (e.g., 1/4 tiling for TRMM divides its global grid into 4 equal subgrids).



Teng, W., H. Rui, R. Strub, and B. Vollmer. Optimal reorganization of NASA earth science data for enhanced accessibility and usability for the hydrological community, J. Amer. Water Resources Assoc. Forthcoming, 2016.



Data Rods Metrics

2013-01-01 to 2015-11-30

Product	Protocol	# Users	# Files	Volume (GB)
NLDAS_FORA0125_RODS	FTP	8	17,733,371	20,585
NLDAS_NOAH0125_RODS	FTP	5	16,741,164	19,580
GLDAS_NOAH025_RODS	FTP	13	39,654,230	5,946
NLDAS_FORA0125_RODS	NLDAS_FORA	445	241,470	92
NLDAS_NOAH0125_RODS	NLDAS_NOAH	286	187,923	95
GLDAS_NOAH025_RODS	GLDAS_NOAH	487	62,680	36
NLDAS_FORA0125_RODS	WEB_LDAS	300	118,561	1,784
NLDAS_NOAH0125_RODS	WEB_LDAS	336	452,667	6,401
GLDAS_NOAH025_RODS	WEB_LDAS	392	79,844	94
Total			75,271,910	54,613

Users: Number of distinct users

FTP: Get data rods via FTP

WEB_LDAS: Access data rods in ASCII or as Time Series plot via GES DISC Web services

Other protocols: Access data rods via CUAHSI HIS (HydroDesktop)



Summary and Ongoing Work

- Developed operational way to reorganize data that is optimal for user communities that are point-time series oriented.
- Solved the motivating problem presented by CUAHSI HIS: create time series of hourly data, for single grid cells for entire period of coverage.
- Key to all solutions is to reorganize data that is optimal for desired method of data access.
- Ongoing investigation into tiling of data set grids has yielded results that are very encouraging for significantly reducing the generation time for data rods.



Extras

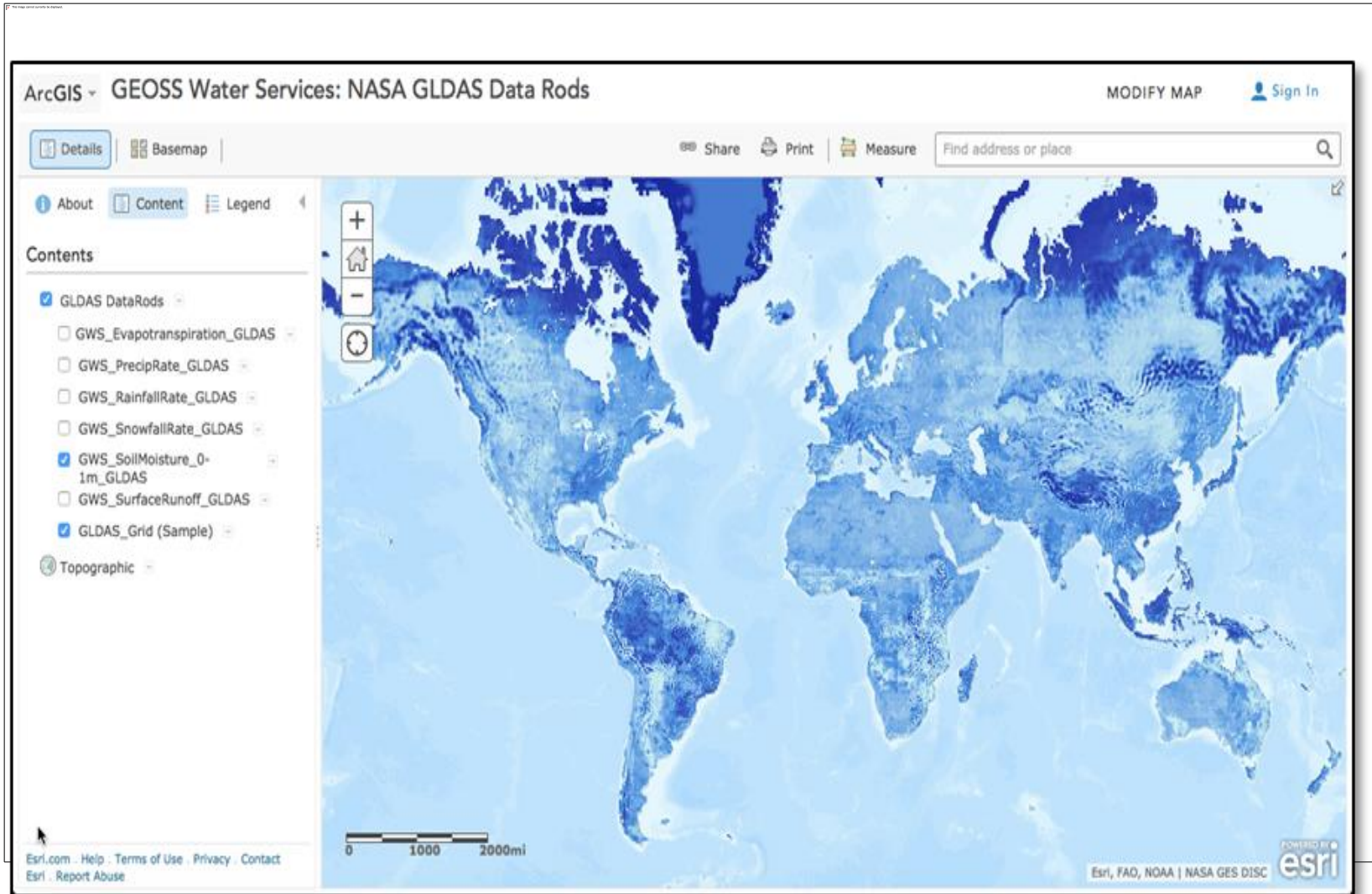


Data Rods

<http://disc.sci.gsfc.nasa.gov/hydrology/data-rods-time-series-data>



Data Rods





Data Rods

<https://www.arcgis.com/home/webmap/viewer.html?webmap=93b7c28dca3b4c86863408a4a90f729f>